

# Events and Measures

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## *An AB 549 Project Interim Report*

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HMG Project #0304*

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## 1. BACKGROUND

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In the 2000-2001 Legislative Session, Assembly Member John Longville introduced a bill targeted at improving the energy efficiency of existing buildings. This bill requires the California Energy Commission (CEC) to conduct a study and provide recommendations for how to save energy and to reduce peak demand in existing residential and nonresidential buildings as a Report to the Legislature.

In response to the AB 549 mandate, the CEC is developing an Action Plan for the legislature. The Action Plan will outline a set of integrated strategies that will cost-effectively reduce peak and overall energy use in existing residential and nonresidential buildings in California. These strategies are likely to include both mandatory approaches, such as new standards, and voluntary strategies, such as market-based programs to support better decision-making by consumers and contractors. Additionally, the Action Plan will identify any obstacles to, and resource requirements for, the Plan's implementation.

Southern California Edison, in cooperation with all of the Investor Owned Utilities (IOUs), San Diego Gas & Electric, Southern California Gas Company, and Pacific Gas & Electric, is supporting the CEC's effort by providing research, analysis and recommendations on cost-effective, market-ready regulatory approaches and strategies to consider as part of the overall effort. The study, of which this is a part, will characterize buildings, mechanisms and potential to guide decisions aimed at maximizing the cost-effective and practical expansion of regulatory strategies that can lead to improvement of the energy efficiency of existing buildings. In some cases, the recommendations that will ultimately emerge from this process will be ready to incorporate into a code revision. In other cases, the steps required before a strategy can be effectively adopted into existing code or the development of new authority will be identified.

The first interim report for this project, Markets and Potential, identified characteristics of the existing building market so as to identify potential areas of opportunity for saving energy in existing buildings. The report's conclusions were:

1. The majority of existing building stock pre-dates the Building Energy Efficiency Standards.
2. The energy efficiency improvement potential is significant.
3. There are already mechanisms in place that impact the existing building markets, and any improvement to those mechanisms should be supported.
4. The potential energy savings from this market justifies further research into expansion of authority, potential trigger events and other strategies to bring about an improvement to the existing buildings stock.

This report, Events and Measures, provides a set of recommended strategies for mandatory approaches to improving energy efficiency in the existing buildings market. The report details key events in the life of an existing building that are opportunities for energy efficiency improvements, and provides a list of promising energy efficiency measures and potential mandatory mechanisms that could be used to enact those measures. Comprehensive strategies are then suggested for further research.

The third report in the series, the Final Project Report, will summarize the top candidate recommendations and will include detailed cost and savings estimates for them.

The California Energy Commission will explore voluntary strategies separately.

## 2. RELATIONSHIP BETWEEN MEASURES, MECHANISMS AND EVENTS

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This report discusses the possible events and mechanisms by which an energy efficiency improvement may be mandated for an existing building. Regulatory options must meet certain criteria to be successful:

- ♦ There must be a well-defined event to “trigger” the improvement opportunity
- ♦ The measures must be technically feasible, market ready and cost effective when implemented in association with that event
- ♦ There must be an administrative mechanism to regulate, enforce and document the action
- ♦ The concerns of impacted stakeholders must be addressed, and attempts made to identify ways to mitigate those concerns

The figure below illustrates the decision process that should be followed for a successful mandate to be developed for each specific measure in a particular building segment. Voluntary alternatives may be more appropriate in certain cases.

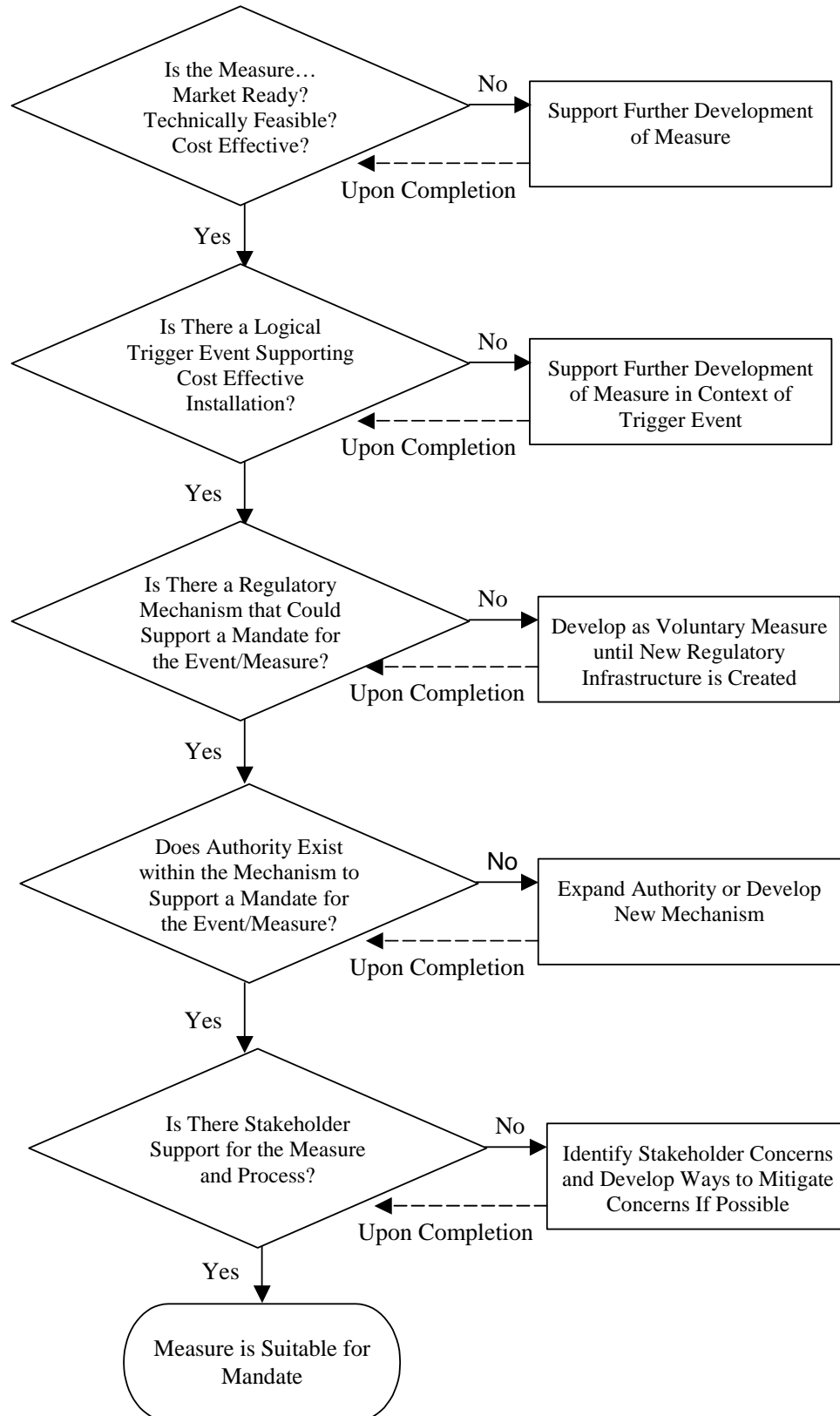


Figure 1: Decision Process for Development of a Successful Mandate

There are many events that occur during the life of a building that present a possible opportunity to improve the energy efficiency of that building. For example, routine inspections that are done for appraisal purposes, securing a loan, or preparing a home for future sale may present opportunities. Figure 2 illustrates that over time, and without intervention, a home's efficiency would begin to deteriorate, causing higher electricity and gas usage. A home's overall energy use may also rise due to the addition of new end-uses such as consumer electronics. However, there are typically many key events that, due to the ongoing maintenance and development of Appliance and Building Efficiency Standards, improve a home's efficiency. For example, when an appliance is replaced, the new unit is likely to be more efficient than the replaced unit due to the increase in stringency of the Appliance Efficiency Standards. If a home is altered, certain altered components must comply with the current Building Energy Efficiency Standard. In the concept drawing of Figure 2, events are illustrated with boxed backgrounds indicating the invocation of the building or appliance standard. The arrows represent the potential for a new trigger for either voluntary action or mandated action. Solid arrows signify appliance upgrades. Dashed arrows signify the trigger event of building resale in which energy efficiency improvements may take place.

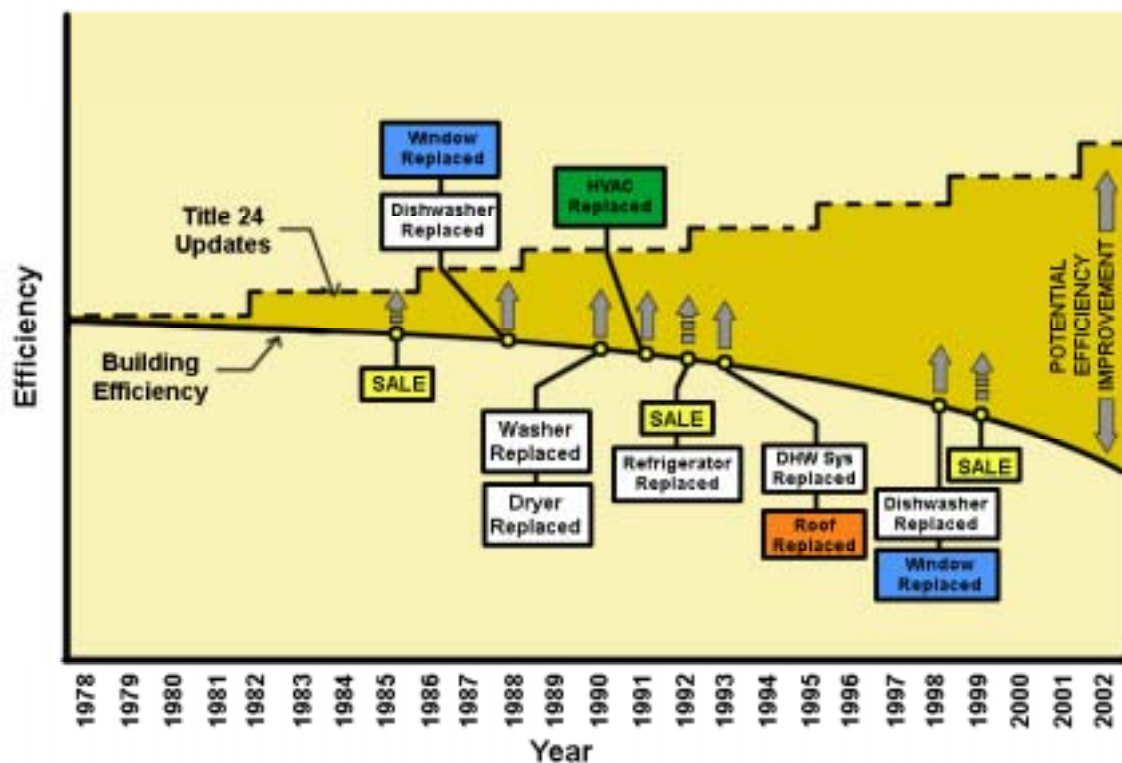


Figure 2: Residential Building Lifetime Events Concept Drawing

Commercial buildings have a similar trigger event potential, as seen in Figure 3. Triggers may or may not invoke an existing standard or mechanism, depending on the nature of the specific event. For example, in the draft 2005 Building

Energy Efficiency Standards, low-sloped roofs, when replaced, must meet the requirements to be classified as a 'cool roof'. In the current Building Energy Efficiency Standards, if more than 50% of the lighting system is replaced, the system must comply with the code. During the life of a commercial building, there may be minor and major alterations performed, occupancy may change (for example from office to retail), leases and sales may occur. The type of building, its original intended use and its location are among the factors that dictate the frequency of any of these events. Potential events are illustrated below

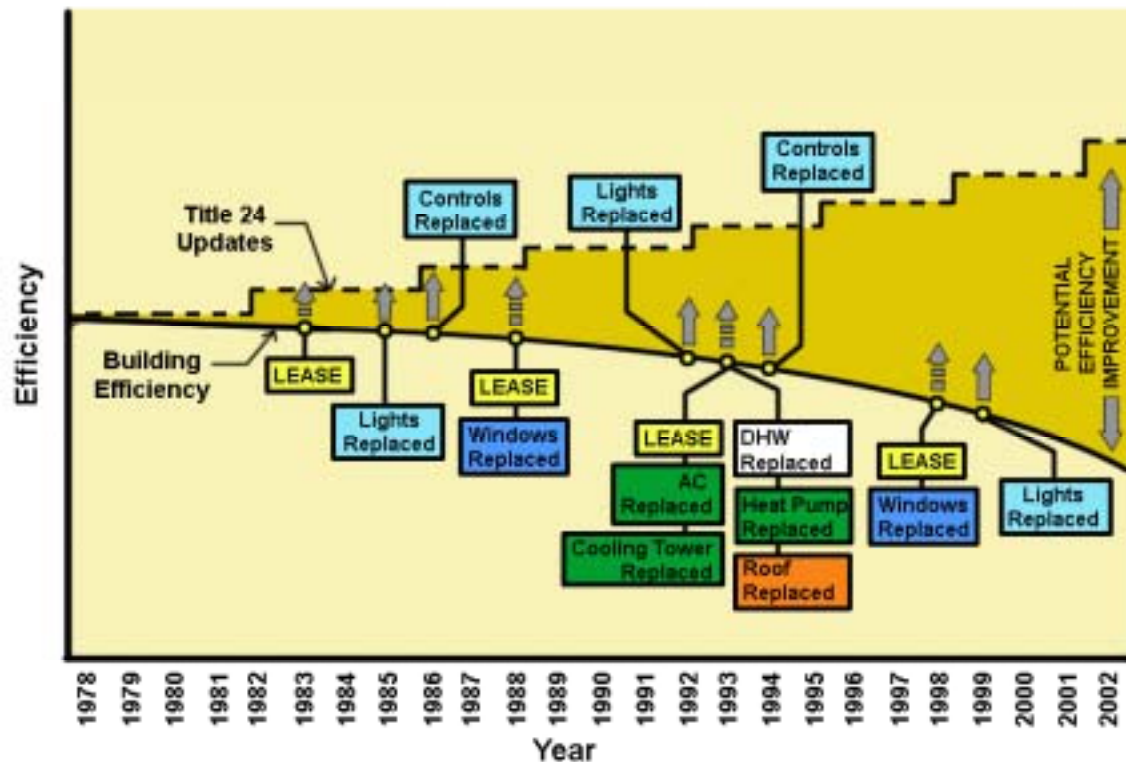


Figure 3: Commercial Building Lifetime Events Concept Drawing

## 2.1 Measures in the Context of Trigger Events

In many cases, specific measure requirements are only feasible in the context of a specific type of event. For example, installation of a cool roof is cost effective upon the trigger event of a roof replacement, particularly in hot climates. However, it is not cost effective upon the trigger event of the sale of a home. Typically, when a component or system is altered or accessed, there is a prime opportunity to consider an upgrade of an ancillary or related feature.

Measures that are cost effective and market ready make the best candidates for a potential mandate. Measure categories under consideration include the building envelope components, heating and cooling systems, lighting systems and water heating systems. These measures are discussed in more detail in Section 5.

## **2.2 Measures in the Context of an Available Administrative Mechanism**

In many cases, there are already mechanisms in place that could be utilized to improve the energy efficiency of a building, whether or not these mechanisms currently impact energy efficiency.

Two mechanisms that deal directly with energy efficiency include the Building and Appliance Efficiency Standards. The Building Energy Efficiency Standards are typically triggered by the need to obtain a building permit. In the process of obtaining the permit, the building owner must prove compliance with the applicable sections of the energy code to the local building department, and the improvements may be subject to inspection. Any changes to the Building Energy Efficiency Standards that might apply to alterations or additions would be addressed here.

The federal and state Appliance Efficiency Standards ensure that, when covered appliances are replaced, the new appliance will meet minimum efficiency guidelines. Appliances that do not cannot be legally sold in California.

In other instances, a regulatory mechanism exists but does not currently address energy efficiency. For example, in the sales transaction of homes and commercial properties certain information is required by law to be disclosed to the buyer such as defects in the property, hazards, liens on the property, and the title history. If a seller were required to identify and disclose a building energy efficiency rating at time of sale, similar disclosure mechanisms could be utilized. It is simpler and less costly to leverage an existing process than it is to create a new one.

Similarly, in the case of a building lease, new tenants often negotiate an alteration as a condition of occupancy. Where the alterations necessitate a building permit, the applicable sections of the Building Energy Efficiency Standards apply. However, no existing regulatory mechanism is available for alterations that do not require a building permit. To enforce efficiency requirements for such alterations, either a new requirement for a building permit would have to be created, or another regulatory mechanism would have to be found or developed. Given the expense and burden of creating a new regulatory mechanism and enforcement process, efficiency improvements that could not be handled by an existing mechanism may be better suited to voluntary mechanisms such as education and training, utility incentive programs, tax incentives, and specially-structured tariffs, at least until an acceptable regulatory mechanism can be developed.

## **2.3 Measures in the Context of Stakeholder Support**

Measures must be cost effective, market ready, and have a clear implementation path in order for stakeholders to support a mandated change aimed at the existing buildings market. Affected groups must have an opportunity to air their concerns and to have them addressed. For example, if building

retrocommissioning were to be considered as a mandated measure or as part of a larger mandate, associations such as the Building Owners and Managers Association (BOMA) should be consulted about how to minimize impacts and costs for building owners. BOMA and other key stakeholders should be involved in development of protocols. If a requirement were to be considered when a building is sold, the real estate industry would need to be included in the development process. The support of key stakeholder groups is critical to success.

In order for a particular measure to be successful as a mandate, the market acceptance must have reached a certain level of maturity. If it has not yet reached maturity, the measure might be better considered as a voluntary one.

Figure 4 illustrates the evolution of market acceptance of a measure.

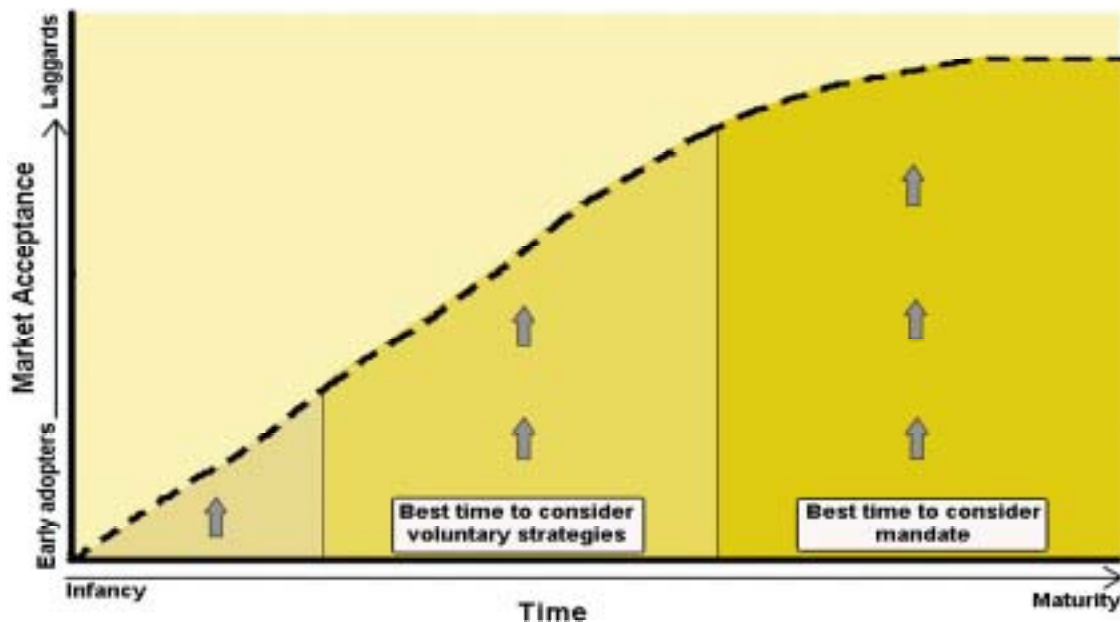


Figure 4: Market Acceptance of Energy Technologies Concept Drawing

Similarly, the initial incremental cost of a measure is another indicator of mandate readiness. If the cost increment is too high, even if the measure proves to be cost effective, the measure may be better suited for voluntary programs that provide incentives. Figure 5 shows that incremental cost must reach a target threshold for the measure to be embraced as a mandate.

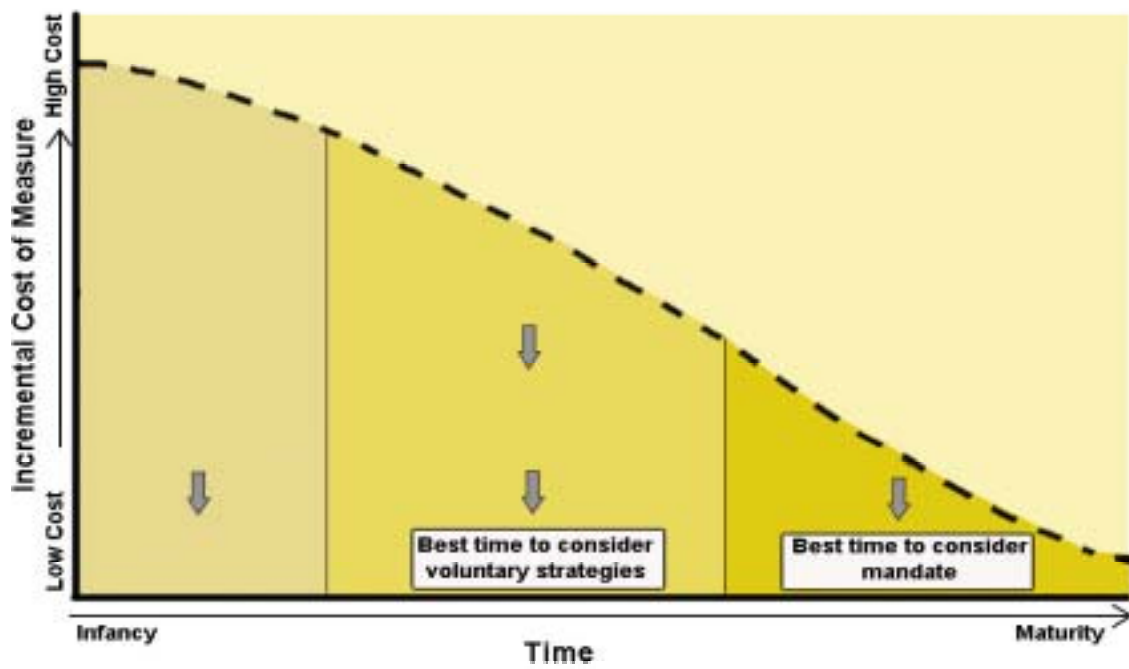


Figure 5: Incremental Cost Concept Drawing

### 3. TRIGGER EVENTS

For a cost-effective measure or set of measures to be implemented during a given trigger event, the trigger must be well defined. The figure below shows the events under consideration, categorized by the motivation or opportunity that the event presents.

|  |
|--|
| <b>Type 1 - Events that involve recording of title or a shift in primary occupants</b><br>Building Sale<br>Building Finance or Refinance<br>Building Lease, sublease or rental   |
| <b>Type 2 - Events that may require a building permit</b><br>Alteration<br>Addition<br>Equipment or building component replacement<br>Change in occupancy type (example: office to restaurant)<br>Change in status from unconditioned to conditioned |
| <b>Type 3 - Events that trigger building component access</b><br>Repair<br>Commissioning or retrocommissioning<br>Scheduled maintenance  |
| <b>Type 4 - Events where site visits to the building are made</b><br>Inspection<br>Energy rating<br>Appraisal<br>EEM evaluation  |
| <b>Type 5 - Events where meter data is gathered or evaluated</b><br>Utility program participation<br>Account inquiry or rate change request  |

*Figure 6: Trigger Events Under Consideration for Improvement in Existing Buildings*

#### 3.1 Type 1 Events

Type 1 events are triggered by the recording of a title or a shift in primary occupants. They include the following events:

**Sale of building** refers to the event when ownership of the building changes hands. For residences, the sale of a home typically is facilitated through a real estate agent or broker. The agent or broker seeks out potential buyers for the residence. After the seller accepts a potential buyer's offer, the residence is placed under escrow through a title company. Escrow is the period in which money and documents for the real estate transaction are held by a third party,

the title company, until the conditions of an agreement are met. The title company processes the legal paperwork involved in the sale. During escrow, many routine inspections may be performed, such as home inspections. This allows professionals access to the building in order to assess the efficiency of the structure. In addition, alterations to the building often occur either shortly prior to or after the sale has been finalized. Another key party involved in the sale of a residence is the mortgage company who finances the buyer's offer for the property, contingent upon an appraisal completed on the residence. The appraisal assesses the value of the residence and is performed by a state licensed practitioner. The completion of a sale results in the recording of a title legally listing the new owners of the residence. Key stakeholders for this event include the real estate, mortgage, appraisal, and home inspection industries.

A similar resale process occurs for real estate transactions for commercial and multifamily buildings. The transaction is facilitated through a real estate company and a title company handles the escrow process once the seller accepts the initial offer. During escrow, the buyer and his/her advisors undertake a "due diligence" process. The due diligence process is similar to the process a careful homeowner would undertake, involving building inspections and an appraisal, but it often includes more extensive reviews of the property's financial records, operating costs, tenant leases, environmental and zoning reviews, and other factors pertinent to the deal. The costs of the due diligence process are born by the buyers, using the services of various specialists. This may include engineers, geologists, hydrogeologists, risk assessment specialists, real estate experts, and other environmental professionals. Also involved in the real estate transaction is the lender who evaluates and approves a loan secured by the property. Key stakeholders for this event include the real estate, mortgage, appraisal, and building inspection industries.

***Building lease, sublease or rental*** refers to the event where the building owner enters into a contract with a third party to lease or rent the building. This event commonly occurs in multifamily buildings. It also occurs frequently in commercial buildings, particularly small retail and office occupancies. In residential buildings, the owner and tenant usually sign a rental arrangement. This agreement documents the move-in condition of the unit and outlines the expectations for both parties. Rental events may occur in single-family buildings in much the same manner. In commercial buildings, however, the process is more formal. Typically, agents are used by both the owner to find tenants and by the tenants to find spaces. Depending on the complexity and length of the lease arrangements, a due diligence process, similar to the procedure complete during a building sale, may occur, although not to the same degree. Also extensive tenant improvement alterations are often negotiated as part of the lease, providing an opportunity to upgrade the building during alteration or to conduct a retrocommissioning study.

In lease and rental agreements, it is specified which party is responsible for the utility bills: the tenant or the owner. If the owner is responsible for the utility bill, there is more incentive for the owner to complete energy efficient improvements

to the building. In the case where the tenant assumes responsibility for the utility bills, the owner will have less incentive for completing energy efficient improvements to the building. For the tenant, the savings alone do not justify the investment in a building they do not own, assuming they obtained permission to alter it. This split incentive is a barrier to energy efficiency improvements in rental property.

**Finance or Refinance** is a process by which a lender evaluates and approves a loan secured by the property, typically with a deed of trust. As with the sale of the building, the loan is contingent upon the completion of an appraisal. Of particular note is the availability of energy efficient mortgages that provide financing for energy efficiency improvements.

### 3.2 Type 2 Events

Type 2 events are triggered by the requirement of a building permit. They include the following events:

**Alteration** is any change to a building's water-heating system, space-conditioning system, lighting system or envelope that is not an addition. It is sometimes done by occupant choice, as in the case of a remodel. It is sometimes done out of necessity, as in the case of a structural problem, such as a leaky roof. Alterations are quite common in existing buildings. The alteration market in California is worth \$7 billion dollars annually.

**Addition** is an alteration to an existing building in which floorspace is added. Most additions require a building permit, depending on local building department regulations.

**Equipment or Building Component Replacement** is a type of alteration that is limited to one system or component. These types of alterations require a building permit in most cases, but portable appliances such as commercial freezers, table lamps and white goods are not covered.

**Change in occupancy type** is a change in the type of occupancy use of a building, as defined by the California Building Code (CBC). If a building owner wishes to change the CBC occupancy for a particular building or space, a permit must be obtained. Depending on the type of change, some upgrades may be required as a condition of the change.

**Change in status from unconditioned to conditioned.** When an HVAC system is installed in a previously unconditioned building, its status changes to conditioned and the full requirements of the Building Energy Efficiency Standards are triggered. The newly conditioned building may already have a lighting system installed, which may have been impacted previously by the lighting standards.

### 3.3 Type 3 Events

Type 3 events are triggered when building components are accessed. They include the following events:

**Repair** occurs when any part or component of an existing building is not in good working order but does not require replacement. When a specific part is being repaired, opportunity may exist to investigate installation of energy efficient features to the system.

**Commissioning** is a systematic process of ensuring that a building performs in an energy-efficient and cost-effective manner meeting the owner's operational needs before the building is occupied. **Retrocommissioning** is a similar process performed after the building is occupied, typically some length of time after a previous commissioning, to optimize building system performance.

**Scheduled or periodic maintenance** involves periodic site visits intended to keep equipment in good working order. A typical example for commercial properties is the maintenance of HVAC equipment. Examples for residential occupancies include exterior painting or roof and gutter treatment. These events do not require a building permit.

### 3.4 Type 4 Events

Type 4 events occur when site visits to the building are made. They include the following events:

**Inspection** is a formal evaluation in which a building and its components are examined in detail to detect faults, violations of development standards, and other problems.

**Home Energy Rating** is the evaluation and scoring of a residential building by a professional energy rater and includes a cost effectiveness analysis of the options that are available for the specific building to improve energy efficiency. Home energy ratings are a necessary step in qualifying a home for energy efficiency financing.

**Appraisal** is an expert or official valuation of a building, typically performed to assure the bank or other lender that the property value matches the financing requirements for the project. Appraisals may also be commissioned by a buyer or a seller in order to negotiate a building's sales price.

### 3.5 Type 5 Events

Type 5 events occur when meter data is gathered or evaluated. They include the following events:

**Utility energy efficiency program participation** refers to a program conducted using public or ratepayer funding that provides rebates, recognition, marketing support or other incentives to upgrade equipment or building features. These

incentive programs can be operated either by utilities or by third party program providers authorized either by the utility or by the Public Utilities Commission. A wide array of program approaches is possible focusing on the type of building, or trigger event that is being targeted.

**Rate change request** is often made when a building's expected energy use changes dramatically. This may be due to an alteration or an occupancy change. It could also be in response to a special offer from the utility. Different rate structures provide different kinds of incentives for energy efficiency. For example, a time of use rate with a high on-peak demand charge can provide a strong incentive for building operators to curtail on-peak energy consumption.

## 4. CURRENT MECHANISMS

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There are two favorable existing mechanisms that could be utilized to a greater extent to improve the efficiency of existing buildings without requiring expansion in legislative authority or extensive development or refinement of the mechanism. The Appliance Efficiency Standards and the Building Energy Efficiency Standards already address equipment replacement and building alteration. These Standards are mandates, and in some cases provide some design flexibility within the mandate.

Future revisions to these Standards could address options not yet exercised to improve efficiency of equipment and components in existing buildings when building owners make replacements or alterations. In some cases, the enabling regulatory authority to support a specific change in the Standards may either be unclear or absent. In those cases, the expansion or acquisition of the proper authority through legislative action may be necessary.

Locally adopted ordinances are another pathway for the facilitation of a mandate. These may be better suited to events and measures that have a good deal of local community support. Providing support for local ordinance adoption may also be a good way to conduct pilot programs around the state, which could help to increase support from the stakeholder community for subsequent statewide mandates.

There are also a number of voluntary mechanisms and strategies that could help to set the stage for future mandates.

A detailed discussion of each of these mechanisms follows.

### 4.1 Appliance Efficiency Standards

The Appliance Efficiency Standards apply to certain appliances manufactured for sale in California. California has the authority to regulate appliances that are not covered by federal standards. Some examples of these are commercial refrigerators, refrigerated beverage vending machines, ground-source and groundwater-source heat pumps, and non-packaged boilers 300,000 Btu/hour or greater. Any new federal standard for appliances previously not covered will automatically preempt any existing California standard for that appliance.

There are currently two rulemaking proceedings underway to update the California Appliance Efficiency Standards. The first is only for residential clothes washers. The second is expected to target other appliances. Table 1 shows the preliminary proposals from which the final target appliances will likely be selected. The table shows the product and the proposed implementation date. For some appliances, the proposal is that there will only be a requirement for testing and certification to the Commission and a subsequent listing if the certified model meets the test standard. In other cases, it is expected that a

performance or prescriptive specification will be developed. These proposals are developed by Pacific Gas and Electric Company and will undergo further public review before moving along a path to adoption.

| Product   | Proposed Implementation Date |
|---|------------------------------|
| Packaged Commercial Refrigeration Equipment             | 2006                         |
| Open Case Refrigerators and Freezers                    |                              |
| Walk-in Refrigerators and Freezers                      | 2005                         |
| Refrigerated Vending Machines                           | 2005                         |
| Water Dispensers  | 2005                         |
| Large Packaged Commercial Air-Conditioners              | 2005                         |
| Ceiling Fans  |                              |
| Evaporative Coolers                                     | 2006                         |
| Whole House Fans  |                              |
| Small Residential Ventilation Fans                      |                              |
| Unit Heaters and Duct Furnaces                          | 2005                         |
| Portable Electric Spas                                  | 2005                         |
| Residential Pool Pumps, Motors, and Controls            | 2005-2007                    |
| Commercial Dishwasher Pre-Rinse Spray Valves            | 2005                         |
| General Service Incandescent Lamps                      |                              |
| Pulse Start Metal Halide High Intensity Discharge Lamps | 2005                         |
| Modular Furniture Task Lighting                         | 2005                         |
| Residential Clothes Washers                             |                              |
| Hot Food Holding Cabinets                               | 2005                         |
| Battery Chargers  |                              |
| Audio and Video Consumer Electronics                    | 2005                         |
| External Power Supplies                                 |                              |
| Television Set Top Boxes                                | 2007                         |
| Portable Room Air Cleaners                              |                              |

*Table 1: Preliminary Topics for Draft Appliance Efficiency Standard<sup>1</sup>*

Expanding the authority, where feasible, of the Appliance Efficiency Standards to include other building components and equipment, is potentially a direct and relatively unobtrusive way to improve efficiency in existing buildings. The mechanism is clean and clear. The number of such units replaced per year determines market saturation.

## 4.2 Building Energy Efficiency Standards

The Building Energy Efficiency Standards for residential and nonresidential buildings were established in 1978 in response to a legislative mandate to reduce California's energy consumption (the Warren-Alquist Act). Within the Building Energy Efficiency Standards, the California Energy Commission has the authority to establish standards for building components and systems that are installed in construction for which a building permit is required (except for institutional

<sup>1</sup> Preliminary draft list provided by Pacific Gas and Electric Company under the Codes and Standards Enhancement Initiative (CASE) Project, a part of the Investor Owned Utility Codes and Standards Program

buildings such as jails, hospitals and nursing homes). "Building components and systems" refers to item that are attached to or considered part of the "building" as defined in the Health and Safety Code. This includes certain additions and alterations in to existing buildings. The Commission does not currently regulate process energy end uses, equipment or components that are not part of the definition of a "building" (e.g. commercial freezers, table lamps and white goods), alterations that do not require a building permit, or manufactured housing.

Updates to the Building Energy Efficiency Standards can be expanded in scope to include more requirements that apply to alterations for existing buildings. In the proposed 2005 standard, there is a requirement that duct systems shall be tested and sealed when an HVAC unit is replaced. This requirement will address the duct leakage problem common in existing homes and commercial buildings. An example of another expansion area may be the requirements for interior lighting. Currently, 50% of the fixtures need to be replaced for the requirements to be applicable. This threshold could be lowered, for example, to 30% or even lower, affecting many more lighting systems and increasing the frequency of Building Energy Efficiency Standards impact. The proposed 2005 Standards also require that when residential windows are replaced, they must be energy efficient. The Building Energy Efficiency Standards are beginning to more actively regulate alterations to existing buildings, but this is a relatively recent trend.

A candidate measure or strategy needs a mechanism where there is clear and established authority. The lines of authority for the Building Energy Efficiency Standards and the Appliance Efficiency Standards may need to be reevaluated in the context of a candidate measure or set of measures. If the authority is unclear or lacking, steps must be taken to establish that authority or to find another workable mechanism. The primary mechanism for the Building Standards is the building permit and inspection process. For any proposed requirements of energy efficiency upgrades that do not require a building permit, it is important to note that enforcement will not be as effective without the creation of a new enforcement mechanism.

### **4.3 Locally Adopted Ordinances**

Cities and counties often have goals for their communities that serve as motivations to reduce local energy use. These include increased energy independence, reduced living costs, which translates to more disposable income remaining in the community, and a decrease in environmental impacts.

Local governments also represent unique subsets of the state and therefore are more likely to accept mechanisms and strategies that are more difficult to adopt statewide. For example, a statewide requirement for energy performance upgrades at the time of resale would require new statutory authority and development of an effective mechanism working in conjunction with existing real estate law and practices, which could take considerable time to develop. However, in a local community with strong support for energy efficiency, such a

requirement could potentially be adopted and prove successful. Local pilot programs refine procedures and develop support for a statewide mandate.

In addition, local governments, especially cities, have a relatively uniform climate across their jurisdiction. This makes it much easier to address climate-dependent measures. Local communities can also pass energy requirements that are more stringent than those of the state. For example, a city could require that all homes, when re-roofed, must install a cool roof meeting the specifications of the current compliance option in the Building Energy Efficiency Standards. It could require the same of commercial buildings regardless of the slope of the roof (the 2005 requirement only applies to low-slope roofs). In order to do this, the local ordinance would have to be reviewed and approved by the Energy Commission. The primary criteria for approval are: 1) the local government must conduct a study to demonstrate that the local ordinance exceeds the stringency of Title 24 and 2) the local standards must be cost effective.

Local adoption can also fuel some problems when one of the long-term goals is to provide statewide consistency in efficiency standards. Each jurisdiction may form a unique pocket of stringency, causing confusion amongst and between regions. It can also confuse the marketplace if several versions of a similar code are adopted.

Encouraging the adoption of local efficiency ordinances may work best as an initial step prior to statewide implementation of a mandate for resale. This approach could be used to test and prove that the additional paperwork and process involved in a time-of-sale mandate is workable without disruption to the sales and escrow process.

#### **4.4 Voluntary Mechanisms**

Utility-sponsored incentives, pilot programs, marketing campaigns and other voluntary efforts have a significant role to play in creating efficient existing buildings. Other, non-utility mechanisms, such as tax credits, rebates, appraisal points, building energy efficiency ratings and awards could also provide information, recognition and financial incentives to create change.

The public utilities and the investor owned utilities have, over the years, sponsored and administered many incentive based programs to promote efficiency in existing buildings. These programs are popular and successful. Utilities have developed a good working relationship with the retrofit supply chain players and they continue to play an important role in the promotion of efficiency measures.

Not only are these voluntary programs effective in their own right; they also help to set the stage for adoption of a later mandate when the market becomes more mature. However, they only reach the segment of the population knowledgeable about and willing to participate in the program. Another downside of voluntary programs is the often-changing amount of resource availability. Long-term success is contingent on consistent financial and technical support.

The California Energy Commission staff will be investigating potential new voluntary strategies in the next step of their AB 549 Project.

## 5. MEASURES

In this section, we look more closely at measures that may be appropriate for regulatory mandates, either in the near term or the long term. We first review the potential trigger events that compliment a regulatory effort.

### 5.1 Trigger Events Appropriate for Mandated Measures

The most promising trigger events are those where there is already an enforcement mechanism in place that would assist in the implementation of a new mandate. The Type 1 and Type 2 events are shown as bold in the table below meet those criteria.

|  |
|--|
| <b>Type 1 - Events that involve recording of title or a shift in primary occupants</b> |
| <b>Building Sale</b>   |
| <b>Building Finance or Refinance</b>   |
| <b>Building Lease, sublease or rental</b>  |
| <b>Type 2 - Events that may require a building permit</b>                              |
| <b>Alteration</b>  |
| <b>Addition</b>  |
| <b>Equipment or building component replacement</b>                                     |
| <b>Change in occupancy type (example: office to restaurant)</b>                        |
| <b>Change in status from unconditioned to conditioned</b>                              |
| <b>Type 3 - Events that trigger building component access</b>                          |
| Repair   |
| Commissioning or retrocommissioning  |
| Scheduled maintenance  |
| <b>Type 4 - Events where site visits to the building are made</b>                      |
| Inspection   |
| Energy rating  |
| Appraisal  |
| EEM evaluation   |
| <b>Type 5 - Events where meter data is gathered or evaluated</b>                       |
| Utility program participation  |
| Account inquiry or rate change request   |

*Figure 7: Trigger Events Appropriate for Mandated Measures*

**Sale of building** already requires a series of inspections and the recording of legal documents pertinent to the specific property as discussed in Section 3. Although the CEC does not have regulatory authority in this area, such permission authority could be obtained from the legislature. In cities and counties, measures could be mandated through locally adopted ordinances.

**Building refinance** does not involve an ownership change and so provides an opportunity for the building owner to leverage additional funds to make energy efficiency improvements. A HERS rating could provide value here. With expanded authority, the HERS rating could be a requirement upon refinancing to the extent that is feasible with respect to federal and state law related to lending.

For multifamily or commercial buildings, the **building lease, sublease or rental** trigger event could provide an opportunity for mandates in specific cases. During this event, legal documents are exchanged between the owner and tenant and typically inspections are performed to document the condition of the building before the tenant takes occupancy.

Type 2 trigger events (**alteration, addition, equipment or component replacement change in occupancy and change in conditioned status**) are all events that often, with few limited exceptions, require a building permit. However, while additions almost always require a permit, alterations only necessitate a permit when required by local building departments. The permit process involves an application and inspection, which is designed to verify the equipment or building component, is installed according to code. Since the primary mechanism for the Building Energy Efficiency Standards is the building permit and inspection process, measures triggered by Type 2 events are, with a few limited exceptions, within the Energy Commission's existing authority. There are some logical applications of and extensions of that current authority that are described in the tables that follow.

### 5.1.1 Measures Suggested for Consideration

Individual prospective measures were selected based on proven energy savings from statewide utility incentive programs, program pilots, and building rating protocols developed by industry consensus. These measures are market ready, cost effective and technologically feasible. While different application scenarios would yield different energy savings and cost effectiveness results, all of the measures listed would merit further review and analysis.

### 5.1.2 How to Read the Measure Review Tables

The tables show candidate measures that could be mandated during the specific trigger event. The first column lists the measures, which are sorted by group. The second column, "candidate measure" serves as an indicator if that measure might be suited to a mandate given certain conditions. The measures with an "X" in the candidate measure column warrant further review. Measures with no 'X' would be better suited to another trigger or for voluntary programs or processes. The specific conditions are listed in the comments column. In addition, the comment column provides clarification for cases where a measure is not appropriate. The tables are intended to spark further discussion, analysis and prioritization.

## 5.2 Measures Review for Single Family Buildings

Table 2 illustrates candidate measures that could be mandated during the alteration or other Type 2 trigger event. The alteration trigger event provides the longest and most promising set of potential measures. This is because there is a proven, existing working mechanism in place and time of alteration is the most logical time to consider related energy efficiency measures.

**Possible Efficiency Measures at ALTERATION Trigger Event - Single Family Building**

| Measure  | Candidate Measure | Comments   |
|--|-------------------|--|
| <b>Integrated Measures</b>                       |                   |  |
| HERS Rating                                      |                   |  |
| HERS Rating and Building Upgrade                 |                   |  |
| HVAC   |                   |  |
| Air Conditioning Plant Efficiency Upgrade        |                   | Appropriate when unit is performing poorly   |
| Boiler or Furnace Upgrade                        |                   | Appropriate when unit is performing poorly   |
| Blower Fan Efficiency                            |                   | More appropriate for appliance standard  |
| Refrigerant Charge and Air Flow measurement      |                   | If unit is a candidate for retrofit and HVAC system is involved  |
| Equipment "Right" sizing                         | X                 | If unit is being replaced as part of the alteration  |
| System type change                               |                   | not likely due to logistical problems  |
| Install Evaporative Cooler or Pre-cooler         |                   | If unit is a candidate for retrofit and HVAC system is involved  |
| Duct Insulation                                  |                   | Require "buried" ducts after sealing and testing   |
| Duct Testing, Sealing, and Retesting             |                   | Already covered under alteration requirements  |
| Ceiling Fan                                      |                   |  |
| Whole House Fan                                  |                   |  |
| Programmable Set Back Thermostat                 |                   | Already covered under alteration requirements  |
| <b>Lighting</b>                                  |                   |  |
| Medium base socket CFLs                          | X                 | Must pass persistence hurdle   |
| Pin-based CFLs                                   |                   | Currently covered if lighting system is involved   |
| Maximize Daylighting                             | X                 | Upon roof replacement - 'offramp' should be provided   |
| Install/Upgrade Lighting Controls                | X                 | Difficult to mandate at this trigger because of personal preferences   |
| <b>Building Envelope</b>                         |                   |  |
| Cool Roofs                                       | X                 | Upon roof replacement only   |
| Radiant Barrier                                  | X                 | Upon roof replacement only   |
| Roof / Attic Insulation                          | X                 | Existing levels must be at or below R19 typically  |
| Floor Insulation                                 |                   | Access issues make first cost prohibitive  |
| Air Infiltration Testing, Sealing, and Retesting |                   |  |
| Wall Insulation                                  | X                 | Appropriate when wall is opened  |
| Window U-factor                                  |                   |  |
| Window SHGC                                      |                   |  |
| Sunscreen  | X                 | One of these three may be possible in hot climate zones upon air conditioner replacement or window replacement |
| Overhangs/exterior shading devices               | X                 |  |
| Integrated Landscape                             | X                 |  |
| <b>Water Heating</b>                             |                   |  |
| Water Heater Energy Factor upgrade               |                   | Appropriate when unit is performing poorly   |
| Tank Insulation                                  |                   | Currently Covered if EF is below .58   |
| Pipe Insulation                                  |                   | Access problems may occur -- extension of lines covered  |
| <b>Appliances</b>                                |                   |  |
| Low-Flow Showerheads / Faucets                   |                   | Appliance Efficiency Standard Applies  |
| Refrigerator                                     |                   | Appliance Efficiency Standard Applies  |
| Efficient Washer & Dryer                         |                   | Appliance Efficiency Standard Applies  |
| Efficient Dishwasher                             |                   | Appliance Efficiency Standard Applies  |
| Pool Pump Motor                                  |                   | Planned for Appliance Efficiency Standards   |

**Table 2: Single Family Measures for Alterations Events**

In Table 3, a list of possible measures to be considered at time of sale is provided.

Intervention at time of sale is not under the Commission's current authority. If authority were expanded, time of sale is an excellent opportunity to evaluate and potentially upgrade the existing stock. In Section 6, supporting locally adopted ordinances or developing special utility tariffs as a way to support efforts aimed at building resale target events is further discussed.

**Possible Efficiency Measures at RESALE Trigger Event - Single Family Building**

| Measure  | Candidate Measure | Comments   |
|--|-------------------|--|
| Integrated Measures                              |                   |  |
| HERS Rating                                      | X                 | Best Candidates for this Trigger Event                               |
| HERS Rating and Building Upgrade                 | X                 |  |
| HVAC   |                   |  |
| Air Conditioning Plant Efficiency Upgrade        |                   | Appropriate when unit is performing poorly                           |
| Boiler or Furnace Upgrade                        |                   | Appropriate when unit is performing poorly                           |
| Blower Fan Efficiency                            |                   | More appropriate for appliance standard                              |
| Refrigerant Charge and Air Flow measurement      | X                 |  |
| Equipment "Right" sizing                         |                   |  |
| System type change                               |                   |  |
| Install Evaporative Cooler or Pre-cooler         |                   |  |
| Duct Insulation                                  |                   |  |
| Duct Testing, Sealing, and Retesting             | X                 |  |
| Ceiling Fan                                      | X                 |  |
| Whole House Fan                                  | X                 |  |
| Programmable Set Back Thermostat                 |                   |  |
| Lighting   |                   |  |
| Increase efficiency of hardwired systems         |                   |  |
| Medium base socket CFLs                          | X                 | Must pass persistence hurdle   |
| Pin-based CFLs                                   | X                 | Difficult to mandate at this trigger because of personal preferences |
| Maximize Daylighting                             |                   |  |
| Install/Upgrade Lighting Controls                | X                 | Difficult to mandate at this trigger because of personal preferences |
| Building Envelope                                |                   |  |
| Cool Roofs                                       |                   | Upon roof replacement only   |
| Radiant Barrier                                  |                   | Upon roof replacement only   |
| Roof / Attic Insulation                          | X                 | Existing levels must be at or below R19 typically                    |
| Floor Insulation                                 |                   | Access issues make first cost prohibitive                            |
| Air Infiltration Testing, Sealing, and Retesting |                   | As part of HERS diagnostic   |
| Wall Insulation                                  |                   | Appropriate when wall is opened                                      |
| Window U-factor                                  |                   |  |
| Window SHGC                                      |                   |  |
| Sunscreen  | X                 | One of these three may be possible in hot climate zones              |
| Overhangs/exterior shading devices               | X                 |  |
| Integrated Landscape                             | X                 |  |
| Water Heating                                    |                   |  |
| Water Heater Energy Factor upgrade               |                   | Appropriate when unit is performing poorly                           |
| Tank Insulation                                  | X                 | If not yet installed   |
| Pipe Insulation                                  |                   | Accessibility issues   |
| Appliances                                       |                   |  |
| Low-Flow Showerheads / Faucets                   | X                 | If not yet installed   |
| Refrigerator                                     |                   |  |
| Efficient Washer & Dryer                         |                   |  |
| Efficient Dishwasher                             |                   |  |
| Pool Pump Motor                                  | X                 | Controls could be required if not already present                    |

**Table 3: Single Family Measures for Resale Events**

During building refinance, both an educational and a financial opportunity are presented. In many cases there is the opportunity to convert equity into low-interest, tax-deductible capital that can be used for energy efficiency improvements. If a HERS evaluation were required during building refinance,

and tied to an Energy Efficient Mortgage, improvements could be made by the homeowner that the homeowner might not otherwise consider. It is not in the Energy Commission's current authority to require inspection at the time of home refinance. If the Legislature were to create this authority, it might also make sense to require certain very basic upgrades to the structure, if they're not already present.

Many times homes are not refinanced as part of a home improvement plan, but rather to capture a favorable interest rate or to liquidate some equity. In those cases, the homeowner may strongly object to being obligated to conduct an energy inspection or complete subsequent improvements.

**Possible Efficiency Measures at REFINANCE Trigger Event - Single Family Building**

| Measure  | Candidate Measure | Comments                              |
|--|-------------------|---------------------------------------|
| <b>Integrated Measures</b>                       |                   |                                       |
| HERS Rating                                      | X                 | Best Candidate for this Trigger Event |
| HERS Rating and Building Upgrade                 | X                 | Good Candidate for this Trigger Event |
| <b>HVAC</b>                                      |                   |                                       |
| Air Conditioning Plant Efficiency Upgrade        |                   |                                       |
| Boiler or Furnace Upgrade                        |                   |                                       |
| Blower Fan Efficiency                            |                   |                                       |
| Refrigerant Charge and Air Flow measurement      | X                 |                                       |
| Equipment "Right" sizing                         |                   |                                       |
| System type change                               |                   |                                       |
| Install Evaporative Cooler or Pre-cooler         |                   |                                       |
| Duct Insulation                                  |                   |                                       |
| Duct Testing, Sealing, and Retesting             | X                 |                                       |
| Ceiling Fan                                      | X                 |                                       |
| Whole House Fan                                  | X                 |                                       |
| Programmable Set Back Thermostat                 |                   |                                       |
| <b>Lighting</b>                                  |                   |                                       |
| Increase efficiency of hardwired systems         |                   |                                       |
| Medium base socket CFLs                          |                   |                                       |
| Pin-based CFLs                                   |                   |                                       |
| Maximize Daylighting                             |                   |                                       |
| Install/Upgrade Lighting Controls                |                   |                                       |
| <b>Building Envelope</b>                         |                   |                                       |
| Cool Roofs                                       |                   |                                       |
| Radiant Barrier                                  |                   |                                       |
| Roof / Attic Insulation                          |                   |                                       |
| Floor Insulation                                 |                   |                                       |
| Air Infiltration Testing, Sealing, and Retesting |                   |                                       |
| Wall Insulation                                  |                   |                                       |
| Window U-factor                                  |                   |                                       |
| Window SHGC                                      |                   |                                       |
| Sunscreens                                       |                   |                                       |
| Overhangs/exterior shading devices               |                   |                                       |
| Integrated Landscape                             |                   |                                       |
| <b>Water Heating</b>                             |                   |                                       |
| Water Heater Energy Factor upgrade               |                   |                                       |
| Tank Insulation                                  |                   |                                       |
| Pipe Insulation                                  |                   |                                       |
| <b>Appliances</b>                                |                   |                                       |
| Low-Flow Showerheads / Faucets                   |                   |                                       |
| Refrigerator                                     |                   |                                       |
| Efficient Washer & Dryer                         |                   |                                       |
| Efficient Dishwasher                             |                   |                                       |
| Pool Pump Motor                                  |                   |                                       |

**Table 4: Single Family Measures for Refinance Events**

### 5.3 Measures Review for Multifamily Buildings

As with single-family buildings, the alteration trigger event provides the longest and most promising set of potential measures. This is because there is a proven, existing working mechanism in place and time of alteration is the most logical time to consider related energy efficiency measures.

**Possible Efficiency Measures at ALTERATION Trigger Event -- Multifamily Buildings**

| Measure  | Candidate Measure | Comments  |
|--|-------------------|---|
| Integrated Measures                              |                   |   |
| HERS Rating                                      |                   |   |
| HERS Rating and Building Upgrade                 |                   |   |
| HVAC   |                   |   |
| Air Conditioning Plant Efficiency Upgrade        |                   | Appropriate when unit is performing poorly                          |
| Boiler or Furnace Upgrade                        |                   | Appropriate when unit is performing poorly                          |
| Blower Fan Efficiency                            |                   | More appropriate for appliance standard                             |
| Refrigerant Charge and Air Flow measurement      | X                 | If unit is a candidate for retrofit and HVAC system is involved     |
| Equipment "Right" sizing                         | X                 | If unit is being replaced as part of the alteration                 |
| System type change                               |                   | Not likely due to logistical problems                               |
| Install Evaporative Cooler or Pre-cooler         |                   | If unit is a candidate for retrofit and HVAC system is involved     |
| Duct Insulation                                  |                   |   |
| Duct Testing, Sealing, and Retesting             |                   |   |
| Ceiling Fan                                      | X                 |   |
| Whole House Fan                                  |                   |   |
| Programmable Set Back Thermostat                 |                   | Already covered under alteration requirements                       |
| Lighting   |                   |   |
| Increase efficiency of hardwired systems         | X                 |   |
| Medium base socket CFLs                          |                   |   |
| Pin-based CFLs                                   |                   |   |
| Maximize Daylighting                             | X                 | In common building areas upon roof replacement                      |
| Install/Upgrade Lighting Controls                |                   |   |
| Building Envelope                                |                   |   |
| Cool Roofs                                       |                   |   |
| Radiant Barrier                                  |                   |   |
| Roof / Attic Insulation                          | X                 | Upon reroofing  |
| Floor Insulation                                 |                   |   |
| Air Infiltration Testing, Sealing, and Retesting |                   |   |
| Wall Insulation                                  | X                 | Possible for re-painting projects in which the wall is opened       |
| Window U-factor                                  |                   | Already covered under alteration requirements                       |
| Window SHGC                                      |                   | Already covered under alteration requirements                       |
| Sunscreens                                       |                   |   |
| Overhangs/exterior shading devices               | X                 | Could be required in some climate zones -- tied to bldg orientation |
| Integrated Landscape                             |                   |   |
| Water Heating                                    |                   |   |
| Water Heater Energy Factor upgrade               |                   | Appropriate when unit is performing poorly                          |
| Central Water Heating Controls                   | X                 | If not already installed when boiler is replaced                    |
| Tank Insulation                                  |                   |   |
| Pipe Insulation                                  | X                 | On recirc systems if not already installed when boiler is replaced  |
| Appliances                                       |                   |   |
| Low-Flow Showerheads / Faucets                   | X                 |   |
| Refrigerator                                     |                   |   |
| Efficient Washer & Dryer                         |                   |   |
| Efficient Dishwashers                            |                   |   |
| Pool Pump Motor                                  |                   | Planned for appliance efficiency standard                           |

**Table 5: Multifamily Measures for Alterations Events**

In the case of multifamily buildings, the sale event is much like the refinance event. The building owner is not the occupant, so there is less motivation to

make improvements during a sale or refinance, particularly if they are not part of a larger effort involving alteration. Given expanded CEC authority, an inspection involving a customized list of suggested energy improvements to the building could be required and would constitute a good candidate measure. Requiring minimum upgrades that are low cost and cost effective could also be considered at this time.

**Possible Efficiency Measures at SALE or REFINANCE Trigger Event -- Multifamily Buildings**

| Measure  | Candidate Measure | Comments   |
|--|-------------------|--|
| <b>Integrated Measures</b>                       |                   |  |
| HERS Rating                                      | X                 | Best Candidate for this Trigger Event  |
| HERS Rating and Building Upgrade                 | X                 | Good Candidate for this Trigger Event  |
| <b>HVAC</b>                                      |                   |  |
| Air Conditioning Plant Efficiency Upgrade        |                   |  |
| Boiler or Furnace Upgrade                        |                   |  |
| Blower Fan Efficiency                            |                   |  |
| Refrigerant Charge and Air Flow measurement      | X                 |  |
| Equipment "Right" sizing                         |                   |  |
| System type change                               |                   |  |
| Install Evaporative Cooler or Pre-cooler         |                   |  |
| Duct Insulation                                  |                   |  |
| Duct Testing, Sealing, and Retesting             | X                 |  |
| Ceiling Fan                                      | X                 |  |
| Whole House Fan                                  |                   |  |
| Programmable Set Back Thermostat                 |                   |  |
| <b>Lighting</b>                                  |                   |  |
| Increase efficiency of hardwired systems         | X                 | Outdoor and common area lighting   |
| Medium base socket CFLs                          |                   |  |
| Pin-based CFLs                                   |                   |  |
| Maximize Daylighting                             |                   |  |
| Install/Upgrade Lighting Controls                |                   | See Building and Grounds Measures below  |
| <b>Building Envelope</b>                         |                   |  |
| Cool Roofs                                       |                   |  |
| Radiant Barrier                                  |                   |  |
| Roof / Attic Insulation                          | X                 | Possible measure - small market share  |
| Floor Insulation                                 |                   |  |
| Air Infiltration Testing, Sealing, and Retesting |                   |  |
| Wall Insulation                                  |                   |  |
| Window U-factor                                  |                   |  |
| Window SHGC                                      |                   |  |
| Sunscreens                                       |                   |  |
| Overhangs/exterior shading devices               |                   |  |
| Integrated Landscape                             |                   | May be too time consuming for this event but could require submission of a shading plan and schedule |
| <b>Water Heating</b>                             |                   |  |
| Water Heater Energy Factor upgrade               |                   | Appropriate when unit is performing poorly   |
| Central Water Heating Controls                   | X                 |  |
| Tank Insulation                                  |                   |  |
| Pipe Insulation                                  |                   |  |
| <b>Appliances</b>                                |                   |  |
| Low-Flow Showerheads / Faucets                   | X                 |  |
| Refrigerator                                     |                   |  |
| Efficient Washer & Dryer                         |                   |  |
| Efficient Dishwashers                            |                   |  |
| Pool Pump Motor                                  | X                 | Install more efficient motor or controls if below threshold  |

**Table 6: Multifamily Measures for Sale or Refinance Events**

The rental trigger event in multifamily buildings occurs frequently but addresses only a small fraction of the building area at a time. In addition, the vacancy time frame is typically short and would not invite improvements that were beyond

necessary repairs. There is also typically no economy of scale provided for these improvements, as units are vacated and rented unpredictably.

**Possible Efficiency Measures at RENTAL Trigger Event -- Multifamily Buildings**

| Measure  | Candidate Measure | Comments                    |
|--|-------------------|-----------------------------|
| Integrated Measures                              |                   |                             |
| HERS Rating                                      |                   |                             |
| HERS Rating and Building Upgrade                 |                   |                             |
| HVAC   |                   |                             |
| Air Conditioning Plant Efficiency Upgrade        |                   |                             |
| Boiler or Furnace Upgrade                        |                   |                             |
| Blower Fan Efficiency                            |                   |                             |
| Refrigerant Charge and Air Flow measurement      | X                 |                             |
| Equipment "Right" sizing                         |                   |                             |
| System type change                               |                   |                             |
| Install Evaporative Cooler or Pre-cooler         |                   |                             |
| Duct Insulation                                  |                   |                             |
| Duct Testing, Sealing, and Retesting             | X                 |                             |
| Ceiling Fan                                      | X                 |                             |
| Whole House Fan                                  |                   |                             |
| Programmable Set Back Thermostat                 |                   |                             |
| Lighting   |                   |                             |
| Increase efficiency of hardwired systems         |                   |                             |
| Medium base socket CFLs                          | X                 |                             |
| Pin-based CFLs                                   |                   |                             |
| Maximize Daylighting                             |                   |                             |
| Install/Upgrade Lighting Controls                | X                 | Photocell at patio or porch |
| Building Envelope                                |                   |                             |
| Cool Roofs                                       |                   |                             |
| Radiant Barrier                                  |                   |                             |
| Roof / Attic Insulation                          |                   |                             |
| Floor Insulation                                 |                   |                             |
| Air Infiltration Testing, Sealing, and Retesting |                   |                             |
| Wall Insulation                                  |                   |                             |
| Window U-factor                                  |                   |                             |
| Window SHGC                                      |                   |                             |
| Sunscreens                                       |                   |                             |
| Overhangs/exterior shading devices               |                   |                             |
| Integrated Landscape                             |                   |                             |
| Water Heating                                    |                   |                             |
| Water Heater Energy Factor upgrade               |                   | Federal standard applies    |
| Central Water Heating Controls                   | X                 | If not already installed    |
| Tank Insulation                                  |                   |                             |
| Pipe Insulation                                  |                   |                             |
| Appliances                                       |                   |                             |
| Low-Flow Showerheads / Faucets                   | X                 | If not already installed    |
| Refrigerator                                     |                   |                             |
| Efficient Washer & Dryer                         |                   |                             |
| Efficient Dishwashers                            |                   |                             |
| Pool Pump Motor                                  |                   |                             |

*Table 7: Multifamily Measures for Rental Events*

## 5.4 Measures Review for Commercial Buildings

Commercial alterations constitute a \$7 billion dollar per year industry in California. Current standards mechanisms capture a good deal of the efficiency opportunities presented by that active market. However, there is still a good deal of potential to look at logical expansions of current regulations (all under existing

authority) and expansion of authority to regulate related measures and systems during remodel.

| <b>Possible Efficiency Measures at ALTERATION Trigger Event -- Commercial Buildings</b> |                   |        |         |            |           |        |  |
|---|-------------------|--------|---------|------------|-----------|--------|--|
| Measure   | Candidate Measure |        |         |            |           |        | Comments   |
|   | Office            | Retail | Grocery | Restaurant | Warehouse | School |  |
| Integrated Measures   |                   |        |         |            |           |        |  |
| Commissioning   | X                 | X      | X       | X          | X         | X      | Good event for this trigger  |
| HVAC  |                   |        |         |            |           |        |  |
| Air Conditioning Plant Efficiency Upgrade   |                   |        |         |            |           |        | Appropriate when unit is performing poorly   |
| Boiler or Furnace Upgrade   |                   |        |         |            |           |        | Appropriate when unit is performing poorly   |
| Testing Adjusting and Balancing   | X                 | X      | X       | X          | X         | X      | Currently Covered for 10 HP or greater TAB could be part of commissioning and include sheave replacement. Appropriate for HVAC alteration                          |
| Install Variable Speed Drive  |                   |        |         |            |           |        | Currently Covered for 10 HP or greater   |
| Install Evaporative Cooler or Pre-cooler  |                   |        |         |            |           |        | Installation quality issues  |
| Install Economizer  |                   |        |         |            |           |        |  |
| Economizer Testing and Fault Detection  | X                 | X      | X       | X          | X         | X      | Could be required for existing economizers when HVAC system is altered   |
| Duct Testing, Sealing, and Retesting  |                   |        |         |            |           |        | Already covered under alteration requirements  |
| EMS   | X                 | X      | X       | X          | X         | X      | Calibration/ tuning of setpoints when HVAC system is touched   |
| Lighting  |                   |        |         |            |           |        |  |
| De-lamp   |                   |        |         |            |           |        | Probably not applicable for this trigger event   |
| Task Lighting   |                   |        |         |            |           |        |  |
| Increase luminaire efficacy   |                   |        |         |            |           |        | Already covered under alteration requirements  |
| Maximize Daylighting  |                   |        | X       |            |           |        | Not currently required. First cost is high - Big box skylights required if building previously unconditioned   |
| Install/Upgrade Lighting Controls   | X                 | X      | X       |            | X         | X      | Automatic bi-leveler other controls currently not required could be required when lighting systems are altered. Very effective in Warehouse and School occupancies |
| Building Envelope   |                   |        |         |            |           |        |  |
| Cool Roofs  | X                 | X      | X       | X          | X         | X      | Could be expanded to include more roof types   |
| Radiant Barrier   | X                 |        |         |            |           | X      | if applicable per the type of structure  |
| Roof / Attic Insulation   | X                 | X      | X       | X          | X         | X      | Upon reroofing is best   |
| Wall Insulation   |                   |        |         |            |           |        | Already covered under alteration requirements if envelope is altered   |
| Window U-factor   |                   |        |         |            |           |        | Already covered under alteration requirements if envelope is altered   |
| Window SHGC   |                   |        |         |            |           |        | Already covered under alteration requirements if envelope is altered   |
| Overhangs/exterior shading devices  |                   |        |         |            |           |        | Possibly in conjunction with window addition   |
| Integrated Landscape  |                   |        |         |            |           |        | Possibly in conjunction with window addition   |
| Water Heating   |                   |        |         |            |           |        |  |
| Water Heater Energy Factor Upgrade  |                   |        |         |            |           |        | Already covered by appliance efficiency standards  |
| Tank Insulation   | X                 | X      | X       | X          | X         | X      | Could be considered during a related event (replacement of boiler) for small systems   |
| Pipe Insulation   | X                 | X      | X       | X          | X         | X      | Could be considered during a related event (replacement of boiler) Authority for water heating systems could be extended to unconditioned buildings.               |
| Appliances  |                   |        |         |            |           |        |  |
| Vending Machines  |                   |        |         |            |           |        |  |

**Table 8: Commercial Measures for Alteration Events**

The resale trigger event could provide an opportunity for an overall building evaluation and tune up. Although not in current CEC authority, there are some cost effective measures that could be evaluated if such authority were granted.

**Possible Efficiency Measures at RESALE Trigger Event -- Commercial Buildings**

| Measure                                   | Candidate Measure |        |         |            |           |        | Comments   |
|---|-------------------|--------|---------|------------|-----------|--------|--|
|   | Office            | Retail | Grocery | Restaurant | Warehouse | School |  |
| Integrated Measures                       |                   |        |         |            |           |        |  |
| Commissioning                             | X                 | X      | X       | X          | X         | X      | Best Candidate for this Trigger Event  |
| HVAC                                      |                   |        |         |            |           |        |  |
| Air Conditioning Plant Efficiency Upgrade |                   |        |         |            |           |        |  |
| Boiler or Furnace Upgrade                 |                   |        |         |            |           |        |  |
| Testing Adjusting and Balancing           | X                 | X      | X       | X          | X         | X      | Replacing sheaves is reasonable adjustment to fan efficiency   |
| Install Variable Speed Drive              |                   |        |         |            |           |        |  |
| Install Evaporative Cooler or Pre-cooler  |                   |        |         |            |           |        |  |
| Install Economizer                        |                   |        |         |            |           |        |  |
| Economizer Testing and Fault Detection    | X                 | X      | X       | X          | X         | X      | Part of commissioning  |
| Duct Testing, Sealing, and Retesting      |                   |        |         |            |           |        |  |
| EMS                                       |                   |        |         |            |           |        |  |
| Lighting                                  |                   |        |         |            |           |        |  |
| De-lamp                                   |                   |        |         |            |           |        |  |
| Task Lighting                             |                   |        |         |            |           |        |  |
| Increase luminaire efficacy               | X                 | X      | X       | X          | X         | X      |  |
| Maximize Daylighting                      |                   |        |         |            |           |        |  |
| Install/Upgrade Lighting Controls         | X                 | X      | X       |            | X         | X      | Very effective in Warehouse and School occupancies   |
| Building Envelope                         |                   |        |         |            |           |        |  |
| Cool Roofs                                |                   |        |         |            |           |        |  |
| Radiant Barrier                           |                   |        |         |            |           |        |  |
| Roof / Attic Insulation                   | X                 | X      | X       | X          | X         | X      | This is difficult for suspended grid ceilings. Only cost effective if no or minimal insulation present |
| Wall Insulation                           |                   |        |         |            |           |        |  |
| Window U-factor                           |                   |        |         |            |           |        |  |
| Window SHGC                               |                   |        |         |            |           |        |  |
| Overhangs/exterior shading devices        |                   |        |         |            |           |        |  |
| Integrated Landscape                      |                   |        |         |            |           |        |  |
| Water Heating                             |                   |        |         |            |           |        |  |
| Water Heater Energy Factor Upgrade        |                   |        |         |            |           |        |  |
| Tank Insulation                           | X                 | X      | X       | X          | X         | X      | Could be considered for small systems  |
| Pipe Insulation                           |                   |        |         |            |           |        |  |
| Appliances                                |                   |        |         |            |           |        |  |
| Vending Machines                          |                   |        |         |            |           |        |  |

**Table 9: Commercial Measures for Resale Events**

Building lease often involves an alteration that already invokes the building energy efficiency standards. But when it does not, expansion of the scope or authority of the standards to accommodate this would be required for the measures shown below to be possible as mandates.

**Possible Efficiency Measures at Occupancy Change Trigger Event -- Commercial Buildings**

| Measure                                   | Candidate Measure |        |         |            |           |        | Comments   |
|---|-------------------|--------|---------|------------|-----------|--------|--|
|   | Office            | Retail | Grocery | Restaurant | Warehouse | School |  |
| Integrated Measures                       |                   |        |         |            |           |        |  |
| Commissioning                             | X                 | X      | X       | X          | X         | X      | Good event for this trigger if mechanism is developed  |
| HVAC                                      |                   |        |         |            |           |        |  |
| Air Conditioning Plant Efficiency Upgrade |                   |        |         |            |           |        |  |
| Boiler or Furnace Upgrade                 |                   |        |         |            |           |        |  |
| Testing Adjusting and Balancing           |                   |        |         |            |           |        | TAB requirement on change of occupancy - even if alteration is lighting only - could include changing sheaves. |
| Install Variable Speed Drive              |                   |        |         |            |           |        |  |
| Install Evaporative Cooler or Pre-cooler  |                   |        |         |            |           |        |  |
| Install Economizer                        |                   |        |         |            |           |        |  |
| Economizer Testing and Fault Detection    | X                 | X      | X       | X          | X         | X      | Mechanism is needed but potential is great   |
| Duct Testing, Sealing, and Retesting      |                   |        |         |            |           |        |  |
| EMS                                       |                   |        |         |            |           |        |  |
| Lighting                                  |                   |        |         |            |           |        |  |
| De-lamp                                   |                   |        |         |            |           |        |  |
| Task Lighting                             |                   |        |         |            |           |        |  |
| Increase luminaire efficacy               |                   |        |         |            |           |        |  |
| Maximize Daylighting                      |                   |        |         |            |           |        |  |
| Install/Upgrade Lighting Controls         | X                 | X      | X       |            | X         | X      | Possible candidate for wireless controls   |
| Building Envelope                         |                   |        |         |            |           |        |  |
| Cool Roofs                                |                   |        |         |            |           |        |  |
| Radiant Barrier                           |                   |        |         |            |           |        |  |
| Roof / Attic Insulation                   |                   |        |         |            |           |        |  |
| Wall Insulation                           |                   |        |         |            |           |        |  |
| Window U-factor                           |                   |        |         |            |           |        |  |
| Window SHGC                               |                   |        |         |            |           |        |  |
| Overhangs/exterior shading devices        |                   |        |         |            |           |        |  |
| Integrated Landscape                      |                   |        |         |            |           |        |  |
| Water Heating                             |                   |        |         |            |           |        |  |
| Water Heater Energy Factor Upgrade        |                   |        |         |            |           |        |  |
| Tank Insulation                           | X                 | X      | X       | X          | X         | X      | Could be considered for small systems  |
| Pipe Insulation                           |                   |        |         |            |           |        |  |
| Appliances                                |                   |        |         |            |           |        |  |
| Vending Machines                          |                   |        |         |            |           |        |  |

**Table 10: Commercial Measures for Lease Events**

## 6. RECOMMENDATIONS

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After reviewing trigger events and looking at measures in the context of events and available mechanisms, the next logical step is to prioritize further research and analysis. Based on the assessment of the market and the regulatory framework in California, there are at least four major opportunities that provide strong potential for increasing the efficiency of existing buildings beyond the mechanisms that are currently in place. These opportunities could accommodate installation of measures shown in Section 5. These recommendations are discussed in Sections 6.2 to 6.5.

The most promising strategies for the short term involve expansion of the scope of the existing Building Standards and Appliance Standards. These strategies are listed in Section 6.1.

Expanding authority into a new direction is a good long-term strategy. However, the market must evolve to a certain level of maturity for new mandates driven by expansion of authority to be successful. A utility-sponsored or otherwise voluntary strategy often works to set the stage for a more acceptable mandate later.

### 6.1 Expand Building and Appliance Standards Regulations

The most straightforward path to increasing energy efficiency requirements in existing buildings is through the current existing mechanisms. The Building Energy Efficiency Standards impacts the existing building market through requirements for alterations in existing buildings. The Appliance Efficiency Standards impacts the existing building market through requirements for appliances and equipment sold or offered for sale in California. New measures can be relatively quickly adopted through an established process that utilizes standardized cost effectiveness criteria, review and acceptance through a public process. Also, the enforcement channels are typically well established.

#### 6.1.1 The Building Energy Efficiency Standards Expanded Areas

The following code changes could be considered during a future Building Standards update:

- ♦ **Creating efficiency requirements for residential landscape lighting and controls.** “Landscape lighting” or the luminaires that are typically used for landscape lighting would need to be defined. Then, the efficiency of the lighting system as a whole (LPD, control credits) could be regulated under the Building Energy Efficiency Standards. This candidate requirement would take further research to determine if the savings potential was large enough to justify the expense for regulation.

- ♦ **Lowering the threshold for nonresidential lighting alterations.** We recommend that the Standards be changed to require lighting systems to meet the lighting power density requirements when 30% of the fixtures are being replaced during alteration (as opposed to the current 50% criteria). This would increase the number of lighting alterations that would be required to comply with the lighting power densities required for new construction. The enforcement mechanism would be the local building departments' permitting and enforcement process. The typical paybacks for lighting improvements are 6 months to 3 years, depending on the occupancy type, the age and efficacy of the equipment removed and the actual LPD and control systems installed.
- ♦ **Requiring appropriate lighting controls for alterations.** This suggestion is based on the work done for the 2005 Standards. In certain space types, occupancy sensors have short payback periods. Where there are skylights or a significant amount of daylight, photocontrols could help capture the energy savings potential provided by the natural light. Currently there are power adjustment factor credits for newly constructed buildings. These could become requirements in areas where lighting design, occupancy type and space needs allow. The code governing alterations would then require these mandatory controls.
- ♦ **Revising and expanding the requirements for cool roofs.** Requirements could be expanded to residential roof replacement and to various additional slope and roof type configurations. This is a logical extension of the requirements and authority within the existing Standards.
- ♦ **Requiring replacement boilers serving multifamily buildings be retrofitted with controls if they are not already present.** Similar to the logic behind the duct sealing upon HVAC unit replacement, the ancillary systems, (pumps and their controls) should be upgraded at the time of replacement.

In addition, others options and potential code changes targeting existing buildings could be identified and vetted through a public comment process.

### 6.1.2 The Appliance Efficiency Standards Expanded Areas

The following code changes could be considered during a future Appliance Standards update:

- ♦ **Creating appliance efficiency requirements for residential landscape lighting and controls.** "Landscape lighting" or the luminaires that are typically used for landscape lighting would need to be defined. Then either the luminaires (lamps, ballasts, transformers) could be regulated under the Appliance Efficiency Standards. This candidate requirement would take further research to determine if the savings potential was large enough to justify the expense of creating an appliance efficiency regulation.

- ♦ **Creating appliance efficiency requirements for residential high efficacy lighting fixtures.** Currently, the residential lighting market is very scattered. There are numerous fixture types with various pin configurations. Creating a standard will help direct the market.
- ♦ **Refining the appliance efficiency requirements for residential setback thermostats.** Residential setback thermostats present an ongoing problem because data shows that they are frequently used incorrectly. While the energy implications of thermostat bypass may or may not decrease energy usage, it is time to consider adding a demand responsive performance specification to the thermostat capability requirements. This work should be done in conjunction with a larger effort on regulating control capabilities (see Section 6.3)

In addition, others options and potential code changes targeting existing buildings could be identified and vetted through a public comment process.

## 6.2 Rate the Relative Efficiency of Existing Buildings and Evaluate Cost Effective Improvements

Another promising strategy with strong potential for increasing the efficiency of existing buildings is rating the relative efficiency of buildings and evaluating buildings for cost effective improvements. In residential buildings, Home Energy Rating Systems (HERS) provide a standardized evaluation of a home's energy efficiency and expected energy costs. Although no such equivalent rating system exists for commercial buildings, retrocommissioning could be considered a commercial counterpart. During retrocommissioning, commercial buildings are tested and tuned to optimize their operation. Cost effective retrofits may also be identified during this process.

### 6.2.1 Home Energy Rating Systems

The Energy Commission has the responsibility to provide oversight and standardize HERS ratings in California. The Commission has begun this process by adopting regulations for HERS raters to perform Title 24 field verification of certain efficiency measure installations (e.g. tight ducts). The 2005 proposed Standards require additional measures to be subject to HERS rater field verification. While the Commission approves HERS providers to provide training, quality control and data collection related to HERS raters, the Commission has not yet developed regulations for oversight of HERS ratings for *existing* residential buildings – a necessary step in creating consistency in the HERS ratings protocol. RESNET<sup>1</sup> provides some standards at the national level.

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<sup>1</sup> Residential Energy Services Network, <http://www.natresnet.org/>

The HERS infrastructure is already set up to provide home energy ratings and cost effectiveness analyses. Moreover, most of the HERS providers have worked in some capacity with the utilities, or the state/ local governments in California.

Ratings can be used in a variety of ways to motivate building owners to accomplish cost effective energy efficiency improvements. As awareness of relative performance differences among buildings increases, owners are more likely to take voluntary action. Also, as the number of HERS evaluations increases, the data could be used to compile energy efficiency information that can be factored in property appraisals about different properties. Other ways a rating could be utilized:

- ♦ The sale or lease of a building could be contingent on having a rating done and the results provided to prospective buyers or tenants
- ♦ A threshold could be established, above which financing and recognition could be earned (like Energy Star or EEM qualifying requirements)
- ♦ A threshold could be established, above which the owner would be entitled to a favorable utility tariff
- ♦ A threshold could be established, and improvement requirements could be imposed on buildings falling below the threshold
- ♦ Sale or lease of a building could be contingent on a certain minimum score threshold
- ♦ Expedited permit service or local recognition could be contingent on a certain minimum score or mandatory installation threshold. One example is the Community Energy Efficiency Program (CEEP), a voluntary program designed by California local governments, homebuilders, utilities and the California Energy Commission. Local building departments involved with CEEP provide special recognition and/or expedited plan checks to builders who construct homes 15% or more efficient than Title 24 requirements.
- ♦ Utility incentives could be made available for encouraging improvement for buildings deemed to have significant potential

Most of these suggestions would require an expansion of current CEC authority. Specific steps to define or acquire the authority would need to be developed.

In the past, a mandatory rating requirement upon resale was seen as a potential bottleneck in a sales process and an inconvenience to the tenant or owner. Any effort to establish a mandatory rating requirement would need to insure that a requirement for rating avoids causing unreasonable time delays in the sales and escrow process.

Such a requirement is not without precedent. The City of San Francisco requires that improvements completed on single-family, two-family and residential hotel buildings must be certified prior to transfer of title. The building owner or his agent records the inspection and certification of resultant work at the county

recorder's office. This process exempts certain buildings and certain types of title transfer.

### **6.2.2 Retrocommissioning**

Retrocommissioning is an extensive look at *systems* performance within an existing commercial building. It is designed to insure that a building performs in an energy efficient and cost effective manner meeting the owner's operational needs. It focuses on HVAC system operation and optimization, lighting control calibration, chiller and boiler control analysis and tuning, development of operations and maintenance protocols and other customized solutions to assure energy efficient and comfortable building operation.

Energy savings are a direct result of building retrocommissioning. The extent of energy savings depends on the pre-existing condition of the building's energy features and the level of depth the retrocommissioning takes. The California Commissioning Collaborative is an ad-hoc group of government, utility and building services professionals who are committed to developing and promoting viable building commissioning practices in California. Their purpose is to facilitate the development of cost effective programs, tools, techniques and service delivery infrastructure that enables the implementation of the building commissioning process in newly constructed and existing buildings.

This group and others could be part of a working group to assist in determining how and under what circumstances building commissioning or retrocommissioning would be practical and cost effective for a statewide mandate.

## **6.3 Encouraging Use of Controls**

Existing buildings typically contain a mix of new and old equipment. It makes economic sense to require replacement of old or inoperable equipment. Whereas it does not always prove cost effective to replace equipment simply because an efficiency upgrade is available on the market, providing controls that optimize the use of equipment makes economic sense for almost all ages of equipment. Controls save energy (and demand) simply by preventing unnecessary equipment operation and, in the ideal case, optimizing the operation of the equipment to the needs of the occupants. This has long been understood, but controls have always been considered similar to individual user behavior: subject to unpredictable operation and not reliable enough to provide predictable savings. They have also been problematic to retrofit into existing buildings. Seeking to avoid these difficulties, we are talking here about controls that could be programmable, wireless, direct digital or other types of 'smart controls' that learn from the user, optimizing energy performance and minimizing the risk of control bypass. Wireless controls can reduce the cost of advanced sensing and control systems, especially in existing buildings where installation of wiring represents 20% to 80% of control project costs. The control industry now provides a wide variety of products that can 'learn' from occupant use, which can

be customized to control smaller areas, either centrally or remotely. Control systems could also be designed to include fault detection equipment with warnings or self-correction. Advanced control systems are widely used in large commercial buildings and are gaining in popularity in smaller buildings and also in the residential sector.

Demand responsive controls provide an additional capability beyond simple energy use reduction. These controls could communicate with a utility or receive a signal indicating a critical peak condition. They could be combined with special tariffs from the utilities that would reflect the value of energy savings during the critical peak time.

Standards are needed for the manufacture and operation of controls, so that they can be relied upon to function as intended. Currently, control functions have little standardization, their implementation and operational modes vary from manufacturer to manufacturer, and users must learn the functions and control sequences of each product individually. Consequently, it is difficult to rely upon all controls to provide the savings that are anticipated. If this reliability can be assured, then utility system planners will have greater confidence in projecting control effects in their planning for future systems investments, and building owners and tenants will be assured that they will realize the promised savings.

Achieving control reliability across all building types and applications will require the development of consistent control algorithms, consistent user interfaces, and smart feedback mechanisms so that users know when controls are working correctly. This is within the current Standards authority. Requiring controls to have certain functions is also within the current authority. However, requiring retrofit of controls upon resale or as part of a building-rating program would require authority expansion. Specific steps to define or acquire the authority would depend on the qualities of the recommended set of control functions. Development of standards for advanced controls would require convening a working group of manufacturers, controls designers, equipment specifiers and building operators. Further investigation is required to create product specifications and application scenarios for a group like this to address. Voluntary programs and incentives would likely be necessary to prepare the market for a future mandate in this area.

## **6.4 Support Special Tariffs and Demand Response Programs**

Dynamic pricing strategies, like real-time and critical peak pricing are getting strong attention in California as market-based tools to curtail or shift load at times when the system is at critical conditions. Senate Bill 1976 calls for an assessment of the feasibility of implementing real-time, critical peak, and other dynamic pricing tariffs for electricity in California. This is an active area of research and can offer options for encouraging electricity reduction in existing buildings.

Dynamic pricing, in particular critical peak pricing, is being studied and supported by the legislature, the Energy Commission, the Public Utilities Commission and is being studied under the PIER program. There may be an excellent opportunity to partner improvements in building efficiency with utility tariffs in such a way that rewards more peak-sensitive building designs.

There is a large savings potential in making the electricity market more demand responsive. Improvements to existing buildings that include demand responsive controls could make a building capable of reducing demand during critical peak times, either as defined by the utility or as defined by the building operator.

Buildings that are retrofitted with certain required controls upon sale could qualify for a special demand response tariff, one that recognized the load shedding value of the controls. In addition, the customer would benefit by having a preferred rate, the utility would benefit by having curtailed or curtailable loads. It may be possible to further tie special demand response tariffs to improvements made to equipment operating during peak load conditions, thereby putting a limit on that building's peak.

For example, if a commercial building owner replaced an air-cooled HVAC system with a water-cooled system, the absolute peak demand that the equipment produced would be substantially lowered. A customer could be placed on a tariff that recognized the value of that reliable peak reduction.

As the chart below illustrates, the major savings opportunities are in commercial and residential air conditioning and commercial lighting.

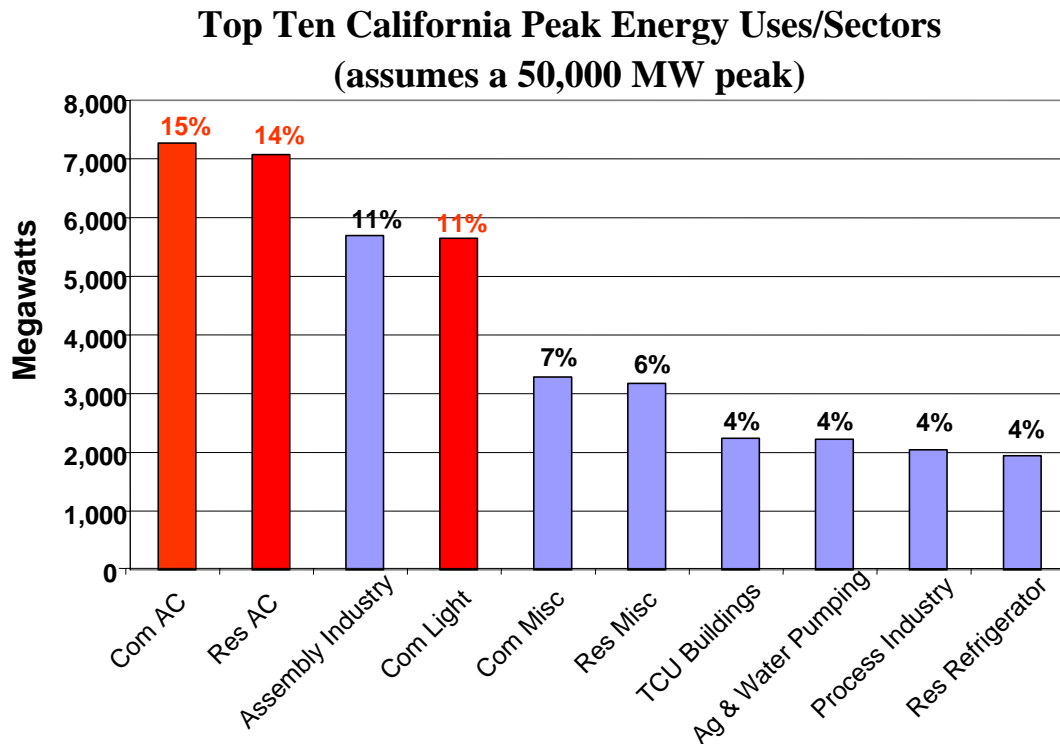


Figure 8: Top Peak Energy Use Sectors

There are three types of dynamic pricing<sup>1</sup>:

1. **Time-of-Use (TOU)** is typically 3 time blocks published in advance for the entire season: Peak, Shoulder, and Off-Peak. This rate cannot address unforeseen weather or equipment failures
2. **Critical Peak Pricing (CPP)** is a high price imposed on a few days a year when energy is expensive or system conditions are critical or near critical. Non-CPP hours are less expensive as a result. The customer pays the critical price when invoked by the utility, and so is incented to reduce usage during the CPP event. The day-ahead forecast of CPP offers added time for response by the customer.
3. **Real-Time Pricing (RTP)** is the hourly marginal cost of a kWh. It reflects hot weather, scarcity, or equipment failure. The day-ahead forecast of RTP offers added time for customer response.

The California Energy Commission is now leading some working groups in this area. Michael Messenger of the California Energy Commission, in a paper presented at ACEEE<sup>2</sup>, described what is needed for success:

<sup>1</sup> Commissioner Art Rosenfeld, California Energy Commission, at the Utility Forum, May 2003

<sup>2</sup> Michael Messenger, California Energy Commission, at the ACEEE symposium on Market Transformation March 2002

- ♦ A functional wholesale market design
- ♦ Customer awareness of wholesale price signals
- ♦ Technology that adjusts demand levels in response to price changes and customer preferences
- ♦ Ability to communicate system emergency conditions to users and technology to respond based on customer input

The CPUC has authority to set rates and require/authorize utilities to install meters and run information programs. The CEC is interested in considering requirements for demand responsive thermostats and controls through Appliance Standards and Building Standards.

The timing is good to look for some common interests between making buildings more efficient with respect to peak loads, controlling those buildings to ensure that their impact on system peak is minimized and providing price signals that reinforce those priorities.

## **6.5 Facilitate Development and Adoption of Model Retrofit Ordinances**

Retrofit ordinances have been adopted and enforced locally, usually to capitalize on the community support for energy efficiency or water conservation. Three examples follow:

- ♦ The City of Roseville adopted two residential programs for retrofit and rebate. The retrofit program requires homes built before 1978 to conduct energy audits at time of sale. The audits can be conducted by a CHEERS rater or by a program representative. Though mandatory, the program has a relatively low participation rate since compliance depends on whether the real estate agent reports the sale to the municipal utility.
- ♦ In 1982, the City of San Francisco mandated a Residential Energy Conservation Ordinance (RECO), which requires all residential property owners to provide certain energy and water conservation measures for their buildings. The RECO requires mandatory compliance on a one-time basis whenever a house, apartment or hotel is sold or when an owner undertakes a major improvement on a single or two-family dwelling in excess of \$20,000, in excess of \$6,000 for buildings with three or more apartments; and in excess of \$1,300 per unit for residential hotels.
- ♦ In 1988, the City of San Francisco also adopted analogous ordinances for commercial buildings. The Commercial Energy Conservation Ordinance (CECO) was particularly far-reaching, requiring optimization of HVAC, lighting, hot water, and motor-driven systems. This optimizing process was a combination of building commissioning and retrofitting which actually upgraded the performance of the systems. Unfortunately, CECO was removed from the Building Code in 1995 by action of the Board of

Supervisors and Building Inspection Commission. (The Commercial Water Conservation Ordinance still stands.)

Support for the adoption of local ordinances is one way the state can facilitate a mandate to improve the efficiency of existing buildings. Cooperative efforts are necessary to encourage widespread adoption of local ordinances that have similar elements, customized for their specific climate and needs.

It is not within the current authority to require local governments to develop or adopt ordinances. However, if the state and the IOU's provided a concentrated amount of technical assistance to these local governments and supported the effort in a high profile way, local governments would be more likely to adopt a set of mandates with common features. An ordinance template or toolkit could be developed that cities and counties could review, modify and adopt for their local jurisdiction. Momentum could be built up over time, particularly if the state cooperatively provided ongoing technical support and training to encourage this effort.

## 7. NEXT STEPS

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The next step in this study will be to choose a short list of the most favorable groupings of trigger events and measures and to further investigate ways to remove identified market barriers and establish working mechanisms. This will be done with feedback from the Codes and Standards IOU team, California Energy Commission and the interested parties who will attend a public workshop being hosted by the Commission. Specific energy savings estimates, based on statewide market data, will then be established. A final report will be prepared, with a list of short and long-term recommended policies, programs and actions.